than the scientific staff of Phipps's Expedition, their stories may consistently be believed, but not otherwise.

When, instead of collecting these hearsay tales, Mr. Barrington asked the Dutch skippers themselves, he got the simple truth from them. "We can seldom," they said, "proceed much higher than 80° 30′ N., but almost always to that latitude." Scoresby once reached 81° 12′ 42″ N.*

The truth is that there is not a shadow of evidence that any ship has ever passed through the Polar pack, and the latitude reached by whalers has depended upon the position of this pack in each season. When there is an early summer, the pack drifts south earlier, and is met with sooner; and when the season has been very severe, it remains closely packed to the northward until much later. In the latter case, it may be that whalers have gone up as far even as 83°, though there is no authentic record of such a voyage. But it seems to be forgotten that the more open water there is round the seven islands to the north of Spitzbergen, the more close and impenetrable will the pack be when it is reached; and that, on the other hand, the sooner the ice is met with, the longer it will have drifted, the looser it will be, and the better chance will there be of boring through it.

Such is the evidence at present before us of whalers having reached incredibly high latitudes. It is utterly worthless.

But Captain Jansen (the author of that charming account of the phenomena of land and sea breezes, in Maury's 'Physical Geography of the Sea') is now engaged in examining some of the ancient Dutch logs, which are still extant, in order to set this matter at rest, and he has kindly promised to transmit the result of his researches to me. He has found a speech made by the learned Pontanus in 1646, in which he says that it is much warmer in 82° north of Nova Zembla than in 76°; but he adds that it is difficult to get there; and still more so to get back; and he, therefore, does not advise any one to try to reach Cathay by that route. With this ancient opinion before him, Captain Jansen will now proceed to search for the data on which it was founded.

ADDITIONAL NOTICES.

(Printed by order of Council.)

1.—*Notes on the Ice between Greenland and Nova Zembla; being the results of Investigations into the Records of Early Dutch Voyages in the Spitzbergen Seas.* By Captain JANSEN, of the Dutch Navy.

Communicated through Mr. C. R. MARKHAM, Sec. R. G. S.

BEFORE giving the results of my investigations concerning the voyages of early Dutch navigators into the Arctic regions, I must premise that I have not been able to find any ships' logs or journals, except those of the voyages of Linschoten and of Barentz. The latter has been printed by the Hakluyt Society.

I believe that our whalers at that time (1613–1750) did not keep regular written logs. It was not the custom of fishermen to do so;

* The Board of Longitude and Sir Edward Parry considered that this was the highest latitude ever reached by a ship, of which there was any authentic record.

and it is only recently that vessels engaged in our herring fisheries have kept logs. In like manner, I believe that our whalers went out every year and came back, keeping only a slate, and no log.

All, or at least the greater number, of the accounts which were brought home, were given, I think, from memory, and before being recorded were perhaps greatly amplified by those who received them from hearsay.

The thick fogs which prevail when the season and the circumstances are favourable for reaching high latitudes in open water, and the foggy and hazy condition of the atmosphere about Spitzbergen and Nova Zembla, prevented any correction of the dead-reckoning, so that errors were cumulative. After the breaking up of the ice in spring, all the broken ice had a tendency to move from the Pole. When the fog cleared away boisterous weather followed, bringing masses of ice down, and obliging the ships to run away from it, so as not to be caught in it unprepared to winter, which would be certain death. Several of the crews of our whalers were lost in that way, and the number of wrecks in the ice became so great every year that the States General were obliged to make a law to regulate the manner in which the whalers were to assist those who had lost their ships.

In the earliest whaling period, when there was no knowledge of the sudden changes in the position and condition of the ice, its movements and dangers, it is natural to suppose that a captain, finding no ice in his way, would steer north as long as he could, and may have reached a high latitude in a favourable year. Torus Carolus, for instance, who in 1634 wrote a book on the art of navigation and sailing-directions, went up the west side of Spitzbergen in 1614, it may be in a boat, to 83°, and found there the ebb-tide running north. But in later years, when our whalers had more experience of the ice, it is not probable that a captain ever ventured to take his ship and crew unprepared into the Polar pack, even if he found a lane of open water.

The general opinion—perhaps only a conjecture, but at that time they believed much more firmly than we do now—was that in high latitudes between Greenland and Spitzbergen, or rather more north, there was a current towards the Pole. There was some plausible reason for this belief, because in latitude 79° to the west of Spitzbergen, in the ice, sailors often observed an eddy in the southerly ice-bearing current, and there was more movement and more danger in the ice in high latitudes than after drifting down. In the latter position they were more easily frozen in or beset, while in high latitudes there was a more easy passage.

This eddy indicated a meeting of currents, it may be of the northerly current, close in shore at Spitzbergen, which turned back, as some whalers suggested, but at a distance of 200 nautical miles west of Spitzbergen. It was rather difficult to find the cause of this eddy so far away; and at that distance, in a usual year, the ice fields were met with.

Soundings and shoals have been found in this ice, and it may be that these are the causes of the eddies. Suffice it to say, that, for this and other reasons, our whalers never tried to get higher than 80°, but invariably entered the west-ice at 79° or 79½°, never higher nor lower.

The Dutch navigators in the Arctic seas, from 1613 to the latter part of the last century, were whalers, not explorers, and therefore, in order to put the results of my investigations in their proper light, it is necessary to give a short insight into the early Dutch whale fishery.

After the voyages of Barentz in 1594, 95, 96, unsuccessful exploring expeditions were sent out in 1603, 1609, 1611, and 1612, towards Nova Zembla. But every one of them failed to find an opening through the ice, and all came back without any result.

In 1613 we commenced the whale fishery, with Biscayans, who at that time were accustomed to fish for whales in the Bay of Biscay or elsewhere.

When our whalers first came to Spitzbergen they met with the whales in great quantities, enjoying all the luxury of this most exquisite feeding ground,—the best perhaps in the whole Arctic region. They were found sporting in open water off shore with their huge backs above water, or taking their *siesta* in a calm bay surrounded by abundance of food. This was a most glorious time for the whales,—the paradise of their history. They did not hide themselves, nor were they afraid of ships or boats, and when they were struck by a harpoon they appeared to be more surprised than grieved. In spite of the yearly increase of whalers, and the great number of whales that were killed on the same spot, they always resorted to this favourite ground. During this first period, called "the Shore Fishery," we had an oil-boiling establishment at Smeerenburg on the Amsterdam Islands, at the north-west point of Spitzbergen. Our whalers went every year straight to this island, anchoring with a land-fast close to the shore, at short distances from each other, so as to leave room for the boats to ply. Every whaler had five, six, and seven boats, and a large complement of men up to 70, employing as many hands as possible afloat and ashore, in killing whales, bringing them ashore, and making oil as fast as they could;

and in some years the harvest was so large that they could not take all the blubber with them at the end of the season, not having room enough in all their ships.

This induced the Directors of the Company—like other good things at that time whaling was a monopoly—to send empty ships for the sole purpose of bringing the first-made oil home to get higher prices. If it happened that the ships came to Spitzbergen before a cargo was ready, and it was a favourable year, some of the captains spent their time in sailing with their ships into the open water north or around the north point of Spitzbergen to the east; but as they had not much time to spare, I do not think that they went any farther than the open water, that is, as far as an occasional more than ordinary northerly current along the coast kept the ice back from the north-east side of Spitzbergen, and produced an open water between this ice and the west-ice or ice-bearing southerly current. This northerly current running from the west side round the north-west point of Spitzbergen keeps the ice from drifting from the east further than Roeveld (East Point of Reindeerland). Sometimes this ice reaches the Zeeuschen Uisky (Look-out Point), but never to the north-west point or Kwaden Hoek (Hakluyt's Headland). The seven islands are always encumbered with ice, and it is impossible to go beyond them, if it is possible to go so far. Therefore I do not think that the northerly current ever has been strong enough to clear the water farther than 83°; and if Torus Carolus was there, and found a northerly current, it was in consequence of the extraordinary strength of the Spitzbergen current in that particular year.

Soon after the discovery of Jan Mayen Island, in 1617, a shore fishery was established there, and although the whalers had great success for some time at this place, the whales were never so abundant there as at Spitzbergen. Thousands and thousands of whales were killed at both places. The consequence was that, in a few years, the whales did not come in as great quantities as before (1626), and finally (1640-50) did not come at all, on the west side of Spitzbergen. As soon as the scarcity of whales was felt, the Directors of the Company made great efforts to follow the whales to their place of retreat. About this time (1626) several ships were sent out on exploring expeditions, ostensibly to seek a north-east passage, but in reality to discover a new and more profitable whaling-ground. Herein lies the reason why the results of those explorations were kept secret. From the charts we know that they did not discover any islands besides those around Spitzbergen, and from the new run of the whalers we know that they did not find another

whaling-ground as easy and profitable as Smeerenburg and its vicinity had been.

It had been remarked that a great number of whales took their flight, when in danger near Smeerenburg, around the north-west point towards the East; and in that direction our whalers went in search of the whales that came no more to the vicinity of that horrible slaughter-place, Smeerenburg.

This new whaling-ground was called "*to the Eastward*," and the whale that was caught there differed from a similar black whale that took his flight to the north-west and west, in the ice-bearing southerly Greenland current. The ice between Spitzbergen and Greenland was called *West-ice*, and the whales that retreated into it the *West-ice* whales. After the havoc at Smeerenburg this *West-ice* whale became shy, cunning, wild, and sometimes desperate.

The other whale, although not different in appearance, was more abundant in unusual years, when the ice east of Spitzbergen and Nova Zembla drifted in greater quantity, and with smaller and flatter floes, much lower down than in a common year; and such an unusual year, in which there was great abundance of this peculiar whale, was called a *South-ice* year, and the whale a *South-ice* whale. This *South-ice* whale was not so shy and not so cunning as the *West-ice* whale, and was, after a hundred years of havoc and slaughter, still more easy to catch. This leads to the conclusion that the *South-ice* years must have been very unusual, otherwise this whale would have been as much altered as the *West-ice* whale.

The whaling-ground *to the Eastward*, north of Spitzbergen, and in and beyond Hinlopen Strait, called "Waigat" (Blow-hole), because the southerly wind blows strong through it, was in some years blocked up with ice, and then the whalers went back round the west side, and anchored at Disco and about the south-east point of Spitzbergen, sending their boats into the ice, because no whale was to be found in open water. These boats had great difficulty in towing the dead whales, with oars and sails, out of the ice on the east coast towards their ships. If a gale from the east or north-east brought this ice into motion, the ships weighed anchor, and retreated to Wibe Tians Bay.

I do not believe that any ship went to the east coast of Spitzbergen from the south, and I am sure that no ship has ever been in the East-ice, between Spitzbergen and Nova Zembla, unless along the coast of Zembla.

If the glorious and luxurious times for the whales had gone by, the whalers and the Company at home were in no better condition, Every year showed a worse result.

Since 1626 it had been a point for consideration whether a party should be left at Spitzbergen and at Jan Mayen Island during the winter, to see if the whales did not come back after our ships had retired, and if they did not leave the shore before our ships arrived. But it was not until 1633 that the Directors decided that a party should winter at both places. The plan may have been decided upon earlier, but it was only carried into effect in 1633. Those who wintered at Jan Mayen island were all dead when our ships returned in May, 1634. Those who wintered at Spitzbergen were found alive when the first boat arrived on the 27th of May, followed on the 30th of May by the whole fleet. Our ships were not expected so soon, and consequently the arrival on the 30th of May was unusually early. In 1634 the experiment was repeated at Smeerenburg, but in the following year not a single man was found alive. All the efforts of the Spitzbergen Company to find the hiding-place of the whales pointed to the ice, west, north, or east, but always among the ice; except, perhaps, to the north of Nova Zembla, but there it was much colder, and the ice often prevented a vessel from getting there.

The *South-ice* fish, being only plentiful in a *South-ice* year, when the whale-fishery was carried on in the *South-ice*, to the southward of Bear Island, and in the junction between the *South-ice* and *West-ice*, and the *South-ice* years being unusual years, our whalers were obliged to go in a common year in search of the *West-ice* whale among the *West-ice*.

Before our whalers gained the required experience for going among the ice-floes and in the ice-fields, and for catching whales in the ice, great losses were suffered, and many disasters had to be deplored; and when all the profit was gone the monopoly was given up. The whaling business was made a free trade, I think, in about 1650; at least, about that time the *West-ice* fishery commenced.

If in former years the Company had a great interest in keeping all the discoveries respecting their trade secret, now every captain, every harpooneer, every ship was as much interested in keeping the secret of their success to themselves; and this may be the reason why no written records were kept of their proceedings.

I often find that the captains, in mentioning a remarkable thing, did not recollect the year in which it happened. If they had kept regular logs they would have gone to them to assist their memories.

The *West-ice* fishery was divided into high and low latitude fishery. The high-latitude fishery ranged between 79½° and 73° N. Lower down was the low-latitude fishery. Every year from 100 to

200 ships went along the Greenland ice up to Spitzbergen Voorland (Prince Charles Island), or straight to 79° or 79½° N., very seldom higher or lower, and steered from thence west, in the ice-bearing southerly current; but only in a common year. In a *South-ice* year they did not go so high, but steered east as soon as they detected that it was such a year. It required a great deal of experience, tact, and good judgment to know, in coming up on the Greenland track, that it was a *South-ice* year. I have not found what the difficulty was. I only find this sentence: "Having ascertained from the shape of the ice, its height, size, and form, that we were in the South-ice, and that it was a *South-ice* year, we steered towards the east."

In a common year the distance of the ice from Spitzbergen varied very much, but it never prevented our ships from reaching 79°. The worst year on record is 1668, in which our ships could not come higher than the Voorland.

In 1696, the 23rd August, a strong westerly wind drifted the ice against the Spitzbergen shore; and some ships saved themselves in the North bay, others in the South and Danish bay, where they were beset in the ice, and on the next night all the water between the ice was frozen. But fortunately, the next morning, the wind coming from the eastward, and blowing from the land, the ice drifted again from the shore, and the ships escaped.

In 1698, in 78° 36′ latitude, 144 nautical miles west of the Voorland, soundings were obtained between 100 and 200 fathoms.

In 1699, in 77° 15′, 224 miles from Spitzbergen, the ships sounded in 150 fathoms, in 77° 9′ they sounded in 170 fathoms, and again in 80 fathoms soft, yellowish, ash-gray clay.

In a common year a vessel must go as far as 224 miles from Spitzbergen, before the real ice-fields are found, some 36 miles long, with smooth water. Sometimes more than 100 ships are attached to the same field.

After entering the broken ice, at a greater or less distance from Spitzbergen, and penetrating until they came to the ice-fields, they drifted with the field down to 75°. On the 1st June, 1698, this drift brought an ice-field in 18 days from 77½° to 75½°. A ship left the field on the 26th of June, and had to sail 142 miles E. by S. through heavy ice, and then 25 or 30 miles through broken ice, before she was in open water.

If the ships had a full cargo, they then went home; if not, they went back again to 79°, or thereabouts, to make the same circuit again, or they went to the old whaling-grounds "to the eastward," to Disco, or to Nova Zembla.

If, after a mild winter, there happened to be a hot summer, and winds favourable for dispersing the ice, then there was a great deal of open water in the ice-bearing current of Greenland, and consequently few whales, for they avoided open water. When our whalers had been unsuccessful in the West-ice, and were induced to go to Nova Zembla, we may conjecture that it was because there was too much open water; and if we are right, then of course they never went to Nova Zembla but in favourable years. But even under such favourable circumstances some captains could not come higher than 73° on the coast of Nova Zembla.

The most favourable year for going north that way must have been a *South-ice* year, when the ice north and east of Nova Zembla came down to the North Sea; and in those *South-ice* years all our whalers had plenty of whales in the *South-ice*, and did not go north.

Still, in other years, when our whalers had been unsuccessful in the *West-ice*, the opening in the ice near Nova Zembla was sometimes found so large that no ice could be seen.

After these rather tedious preliminary remarks, I will give the results of my investigations.

THE SEA AROUND NOVA ZEMBLA.

Theunis Ys, one of the most experienced navigators in the seas near Nova Zembla, where he had often been to kill sea-horses, gives the following data:—

In the beginning of the season the ice first breaks up in 73½° N., or about Cross Bay, where the opening, in some seasons, is so large that the ice cannot be seen from the masthead; but usually it is smaller, more or less, according to the drift of the ice. Sometimes, at Midsummer, several large bays of Nova Zembla remain blocked up with ice.

At Cross Bay the flood-tide comes from the north, but in 76° from N.E., and more to the eastward from the E. Here the flood-tide runs twice as long as the ebb-tide.

In consequence of the strong current at those places, and in the opening of the ice, when it is open, the passage is not easily obstructed, and the ice thaws sooner.

The water, or the ice, rises very high in winter. It is to be seen on the shore, where it leaves traces behind. But drift-wood, although there is plenty on the beach, is found far above this mark, and so remarkably high that "I don't understand," he says, "how it is brought there." When the ice opened in 73° or 73½°, or thereabouts, the floes were broken into small pieces and destroyed.

To the north of Nova Zembla, towards the Pole, large fields of ice are to be seen, but he never saw any land there. In the bays of Nova Zembla the water is pretty deep till you arrive at the most northern point, but more to the eastward they are not so deep.

He was of opinion that no vessel had been higher than 82°, owing to the large ice-fields which are nearly always found to the north of Zembla, although no land can be seen,

He thought that, in some years and at certain times, it would be very easy to go round the east point of Zembla to the coast of Tartary, but to go further eastward it would be very difficult, because, although the water may be open, thick fogs and haze prevail during the summer season.

He thought Nova Zembla was a group of islands, or broken land with straits through it.

At Kostin Shar the ice-floes separate, drifting partly to the north and partly to the south.

There were plenty of whales north of Zembla, but our whalers having no experience in that locality, were not very successful there.

Thus far Theunis Ys.

In 1664 Captain William de Vlamingh sailed along the north and north-east coast of Zembla, round the east point, and steered south and south-west till he came near the house where Barentz wintered in 1596. From thence he sailed in an E.S.E. direction till he was in 74° latitude (dead reckoning always foggy), and saw no ice, but here and there a floe. He did not see land, although there was every indication that he was near land. He sounded in that direction 70 and 80 fathoms; at 74° the water was smooth and the bottom more even. The soundings near Barentz's house, and at the north point close in shore, were 100 fathoms, but they decreased to seaward.

From the islands of Orange, off Cape Lebianoi, he sailed in a north and north-east direction, 280 nautical miles, and found on the Zembla side the bottom to be gravel, rocky and stony; but farther from Zembla it became more muddy and soft, and the sea more shallow. At the end of the above named distance he sounded in 7 and 5 fathoms, and thought there was land, but could not see in consequence of the fog.

It was not so cold this year as in other years.

He thought Nova Zembla was composed of several islands.

He went in a north-west direction from Zembla, as far as 82°. In going from Zembla to the north, the water invariably became more and more smooth, and there was less and less current.

He was of opinion that Greenland stretched behind Spitzbergen, opposite to Zembla, and the coast of Tartary. Up to Kostin Shar

the coast has white sand-hills, and the bottom of the sea is white sand, but farther to the eastward the coast is, like that of Norway, bold high land.

He found that the state of the sea around Nova Zembla, with reference to ice obstructions, depended on the prevailing winds, and on the opening in the ice-barrier between Spitzbergen and Nova Zembla. If there is an opening large enough, and the winds continue to blow for some time from north and north-east, all the ice may be driven down into the North Sea, bringing the *South-ice* whale with it, when it will be a *South-ice* year. The current from the east runs along shore, in the bay and round the point of the ice-cape, C. Lebianoi, sometimes as fast as 120 nautical miles a day. A north-east wind produces the strongest current.

Great masses of ice are found near the islands of Orange, where they cannot escape.

To go more to the eastward in search of a north-east passage, a vessel ought to keep close to the Zembla shore, and go through one of the straits, if a passage can be found through Zembla, and then along the lane of open water close in shore. The straits of Waygats and Nassau are often blocked up with ice, because with easterly and north-easterly winds all the ice is driven into the funnel between Zembla and Tartary, of which the Nassau strait is the narrowest part. There is not much fish on the north coast of Zembla, but great quantities of lobsters.

If there is no frost, there is always fog.

Along the north and south-east coast of Zembla he saw great quantities of driftwood, and the easterly current pointed to the great rivers of Tartary as the direction from whence it came.

The smallest of the three islands of Orange is a rock twice as high as the highest steeple of Amsterdam. At a considerable height, he found on it a very large tree, that three or four men could not lift. This tree was rotten. He found a great many birds' nests in it, and took fifty eggs out of them. The tree lay much too high to have been brought there by water—perhaps by a water-spout, he says. He found, on one of those islands, piles which were placed there by Barentz in 1596.

In 1664 he saw no ice all around Nova Zembla, and none towards the Pole, only here and there a floe; but it was always foggy and boisterous weather.

His highest latitude may have been 82° 10′, at which point he found 7 and 5 fathoms.

Thus far William de Vlamingh, who was afterwards selected to command an exploring expedition to New Holland.

From other sources.

The coast of the most northern and eastern part of Zembla is very rocky, difficult to approach, and for a considerable distance out to sea the bottom is rocky.

The ice-floes, behind and inside Nova Zembla, are much smaller than those about Greenland; also much flatter and not so high, perhaps the larger floes or fields are sooner thawed and may have sunk, or have been melted before our fishers arrived there. The smaller ones are formed in the bays under the land; they are small, thick, and high; they are floated later, and thaw later, and, when once adrift on the sea, they are very dangerous for ships. The cold in the early and late parts of the season causes the pieces of ice to freeze together. In such a case all the ships are frozen in for a short time.

To the north of Zembla, to seaward, there is a dead current, but close in shore the current is very strong, running like a sluice.

The ice moves here with the wind, except close in shore on the north and north-east coast of Nova Zembla. After the north-east wind has blown for some time the sea becomes free of ice. In the summer months the prevailing wind is from north-east. It is very seldom that the sea there is entirely free of ice.

In the log of Barentz:—

"5th October, the sea free of ice.

"26th October, much open water. Although only twilight, we can see tolerably far.

"Christmas day, much open water.

"8th March, no ice to be seen north-east. There must be an open sea north-east from us.

"9th March, much farther no ice to be seen north-east; but in the direction of the coast of Tartary there was ice.

"14th March, strong north-east wind. The sea frozen up again, and colder than before.

"8th and 9th April, wind south-west. Ice drifted away, the sea became more and more free of ice; but 10th April, with a north-east gale, the ice came back.

"3rd May, all the ice gone.

"20th and 21st May, the ice came back with a north-east wind.

"6th June, thunderstorm, with snow, hail, and rain."

Torus Carolus, in his work printed in 1634, says:—"The flood-tide comes into Waygats and the Straits of Nassau from the east, and more to the eastward from north-east. The water rises and falls there too, but it keeps no regular time. The tides along Nova Zembla (I think he speaks of the south-west coast) turn with the moon. A south-east moon makes high water (9 h.). The bottom of the sea

along the coast from C. Canier Nos to Waygats is a gradually rising ground, with hard sand. When the weather is foggy and your lead gives 8 or 9 fathoms, you are 12 or 16 miles from shore; but in 35 or 40 fathoms you are far enough from land. The same is to be observed along Nova Zembla (I think he only speaks of the south-west coast up to 73°) and at the east side of Waygats; but it shallows a little near the entrance to it. Before or rather off Waygats and that part of the coast of Zembla there is always a heavy swell, as in the Bay of Biscay."

Beyond the Straits of Nassau, behind Nova Zembla, ice-floes several fathoms thick drive, even in midsummer, against the coast of Tartary, towards the River Obi and towards the Strait, which may be blocked up in midsummer. The Russians navigate in the coast-water, but only in small vessels; and each time the wind blows from the sea they are obliged to seek shelter in creeks, bights, or rivers, to save their ships and their lives, because their vessels would not stand the pressure of the ice that would be brought down by those sea-winds.

This is all I have been able to find about the Nova Zembla sea.

THE ICE BARRIER BETWEEN SPITZBERGEN AND NOVA ZEMBLA.

The general opinion in the seventeenth and eighteenth centuries was, that every winter all the water around the Pole down to 76°, more or less according to the severity of the winter and local circumstances, was frozen, and that the whales, for their respiration, were obliged to remain during the winter at the edge of the polar pack. But here they found a very scanty supply of food, and therefore they were fatter in the later season of the summer than in the early part of the season, when our whalers found them sometimes as early as April or May very poorly looking.

In the middle of winter, according to Barentz's observations on Christmas Day, there is occasionally a breaking up of the ice—one year's ice or of less age—by the working of the tides or other causes, and then the wind may blow it, assisted by waves and currents, to leeward, leaving open water for a longer or shorter time; and the whales, guided by their instinct, may know this. But they run the chance of being caught in the ice if they go to this temporary open water in search of food. It has often been observed that whales thus caught, knock a hole in the ice with their heads for their respiration, and our whalers saw this done, but did not kill the whales, because their ships also were frozen in and no boats could be used to catch the whale. The circumstance that the

whales in the after season came down from the North, instead of going to the North or to the Pole, was evidence to prove that there was not sufficient water around the Pole for the whales to respirate.

The barrier between Spitzbergen and Nova Zembla being always found in about the same locality, gives rise to the supposition that

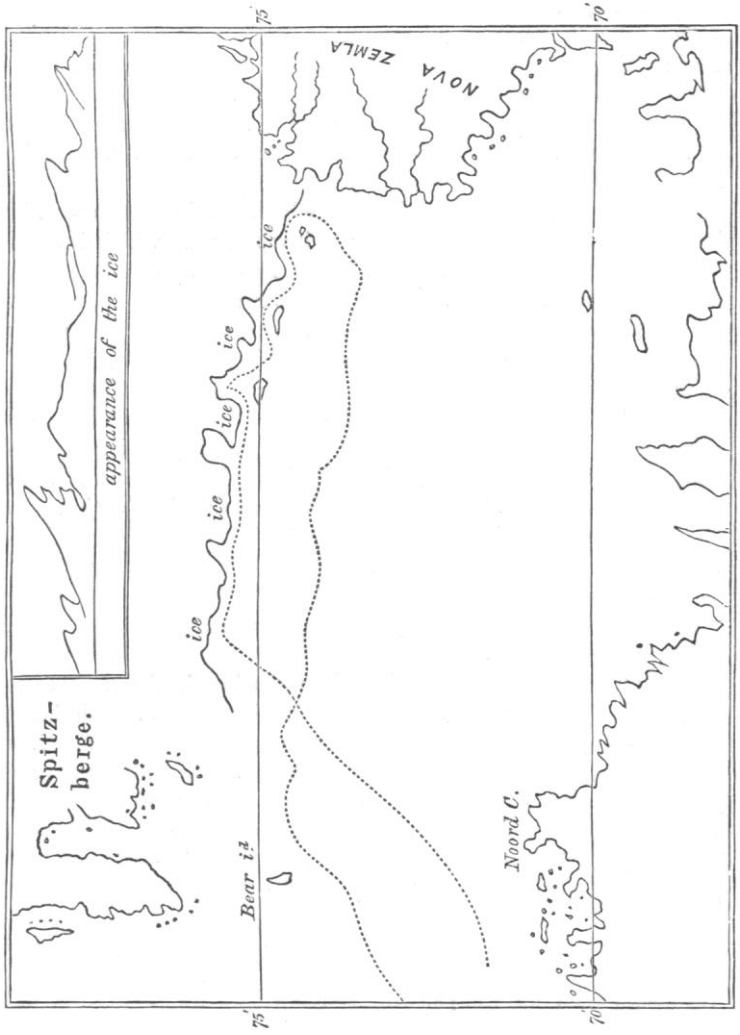

CHART OF THE ICE-FIELD BETWEEN SPITZBERGEN AND NOVA ZEMBLA IN 1676.

there is land or islands, or at least shoals within or behind, by which the ice is prevented from coming down. In this extensive ice-field, shown in the accompanying tracing from a chart dated 1676, no

other openings are known than those along the coast of Nova Zembla, and along the east coast of Spitzbergen; and the latter is easily blocked up by easterly winds. Perhaps there is only an opening on the east coast of Spitzbergen, when the wind blows from the land, and the winds and the weather being very variable at Spitzbergen, blowing at the same time at different places in various directions, it may be that it is kept open for some time. But as the open water depends upon a change of wind, there is little chance of a vessel being rescued, when beset, while the northerly current would bring the ships more and more into the ice. I do not, therefore, think that our whalers ventured in it from the south side.

The straits of Hinlopen, through which the ice-floes are drifted by the northerly current and the south-wind, from which it derived its name of Waigat (Blow-hole), is the first to be clear of ice, and the last to be frozen over. Even when our ships were beset in the ice on the north coast (sometimes for three weeks) it was not frozen, and it appears that the whales made their escape by preference through this strait, guided by their instinct and knowledge where to find open water. Our whalers were afraid to go into this East-ice, although convinced that a great quantity of whales had their feeding-ground and sheltering place there. I do not think that anybody has ever been behind this ice-barrier. In a chart of 1720 I find, to the eastward of the North-east Land, high land seen.* If this is really so, I can understand why the same writer, who publishes a chart of Spitzbergen as an island, says, "We do not know whether Spitzbergen is a real island or a hanging island"—a peninsula.

The only known openings in this extensive ice-barrier between Spitzbergen and Nova Zembla are close in shore of both islands. However Captain Snobbigger says, that being unsuccessful in the West-ice, he went to Disco (Spitzbergen); but he found too much ice there against the coast, and decided to go to Nova Zembla. He went south around Bear Island, and it appears always to have been

* This is probably Gillis Land. In 1707 a very clever captain of great experience in the whale-fishery, named Cornelis Gillis, found towards the end of the season, when he was looking for whales *to the Eastward*, enough open water to go up north along the Seven Islands, and beyond 81°. From thence he steered east and south-east around North-east Land. In the parallel of Great Island, about 80°, he saw high land at a distance of about 100 nautical miles from North-east Land. Van Keulen had it from Gillis himself, and laid it down in his chart.

Zordrager, who was in the whale business at the time, has it in his chart also. He mentions in his work an iceberg in the pack-ice east of Spitzbergen. It may be that this iceberg came from Gillis Land.

Little Ferro.—Van Keulen gives the latitude 82° 25′ without longitude; but I cannot find it in any of his charts.

the rule, in going from the west to Nova Zembla, to go south of Bear Island. Midway between this island and Zembla he met with a long swell, which he thought could only come from the Sea of Tartary or some other large open sea, similar to the Bay of Biscay, otherwise the swell would neither be so large nor so slow. When he arrived at Nova Zembla he found no opening and so much ice that he was obliged to run south to get clear of it. He thought that the opening in that year had been in the locality where he met the large waves.

Captain Ryk-Ys had a similar experience in the same locality. It may be that in some years this ice-barrier has an opening somewhere between Spitzbergen and Nova Zembla; but it is not known.

The southern limit of this icefield stretches from the south-east point of Spitzbergen to Cross Bay in Nova Zembla, with bays and bights in it. Some captains, in taking the usual course round the ice in April, after a severe winter, found the sea from Jan Mayen Island to Spitzbergen, and from thence, Bear Island included, to Nova Zembla, one mass of ice. But the condition of the ice varies very much from year to year. At Jan Mayen Island the current along shore runs to the south-west. At Spitzbergen to the northward along the west and east coast; but more to seaward the current along Greenland runs south down to 75°. Farther down it runs to the south-west. For this reason our whalers supposed that the direction of the coast-line of Greenland must be north and south in high latitudes.

There was a remarkable projection of the ice in the Greenland or West-ice, called the tail of 77° (perhaps 71°?). To the northward of this point the ice ran in a straight line north and south, and to the southward of this point the direction of the edge was straight south-west, as if cut with a knife. In penetrating through this ice 150 or 160 miles to the westward, no land could be seen from the masthead.

In some years our whalers drifted within a few miles of the shore of Greenland in 72°; but although they often intended to go ashore, the Whale Company prevented it. Our whalers have been near the coast of Greenland opposite Iceland, which has since been found inaccessible.

In a common year the south point of Spitzbergen remains, even in winter, free of ice; but after a severe winter it may be, for some 40 or 50 miles to the southward of it, surrounded by broken ice.

In the first days of June the south point and west coast are free of ice. There is a trail of ice which is swung round the south

point by the influence of the northerly current, and this sometimes blocks up the channel near the Voorland (Prince Charles Island).

Between the North Cape (Norway) and Spitzbergen you are always sure to meet ice; chiefly on the Spitzbergen side of the distance in a right line.

The Spitzbergen season closes in the middle of August. Our whalers very seldom stayed there longer, and never till the 1st of September.

The story of a captain sailing round the Pole has never been authenticated. There is another story that a captain of a man-of-war, waiting at Spitzbergen to protect the homeward-bound whaling fleet, having some time at his disposal, and finding open water, went as far as 89°; but there is no evidences of the truth of it. This only shows the general belief that there was no land to prevent it, and that it may be done if there is open water. When our whalers drifted from 79½° in eighteen days, 2° towards the south, attached to a large ice-field 40 miles long, and did it in one season two or three times, they saw that there was always a continuity in those ice-fields; and they calculated that, as during the summer season from 1st June till 31st August, or five times eighteen days, five times the length of ice-fields must drift south, the breadth of the pack must be 10° of latitude, or the distance to the Pole; and that if there was a passage for the ice, there would be one for ships under favourable circumstances. Therefore Torus Carolus says, "Whether there is a passage, God only knows; but if any, it must be sought here."

Another story is given by Witsen. After a close investigation of the highest latitude reached by our whalers, he comes to the conclusion that no one has been higher at the Nova Zembla side. than 82°. Still he says, I am informed with certainty that Capt. Cornelis Roule has been in 84½° or 85° in the longitude of Nova Zembla, and has sailed about 40 miles between broken land, seeing large open water behind it. He went on shore with his boat, and from a hill it appeared to him that he could go three days more to the north. He found lots of birds there, and very tame. No dates are given. It appears that Witsen received this story when his book, 'On North-east Europe and Asia,' was in the hands of the printer (1705), and he had no time to make inquiry.

GO AND SEE IF IT IS TRUE,
AND MAY GOD PROTECT THE EXPLORERS.

From these very meagre data, I venture to deduce the following conclusions:—

1. The warm under-current does not touch Jan Mayen Island, otherwise, as in tropical seas the cold under-current is brought to the surface, where it encounters islands, rocks, or shoals in its way; so this warm current would be brought to the surface, and a northerly current would be observed along the shore, whereas the current along the Jan Mayen Island runs to the south-west.

2. Spitzbergen is situated in the warm under-current, from which it derives the beneficial influence, producing a very mild and variable climate. It is, however, a remarkable fact that there are no shells whatever found on any of the fine sandy beaches in the bays of Spitzbergen.

3. The warm under-current does not touch Nova Zembla south of Cross Bay, because it lies too much behind the North Cape of Norway, and the gradually shelving white-sand bottom on that part of the Nova Zembla coast is probably the consequence of it.

4. It may be that there is a warm under-current along the north coast of Lutke-land, but then it flows in the direction of the coast-line, and remains an under-current, because the surface-current is a very strong current from the east and north-east. This appears to be a tidal current, increasing in strength when it finds an impediment in its way towards the south. Far out to sea-ward there is a dead current, or no current; but it is very strong along the shore of Lutke-land, or Barentz-Land, as it ought to be called.

5. Nova Zembla is much colder than Spitzbergen, being deprived of the beneficial influence of the warm under-current; and instead of deriving any advantage from the proximity of a large continent and its radiation in summer, the heat from this source produces in summer at Nova Zembla north-easterly cold winds, and these winds produce fogs at sea.

6. Has the course of the warm under-current anything to do with the ice-barrier between Spitzbergen and Lutke-land? or ought we to look into the tidal movements around the Pole for the causes of this ice-barrier being stationary there? The flood to the north and south coast of Zembla comes from the east; at Spitzbergen from the south. We know that when different tidal waves meet, they change their direction with or against the moon, but make a revolution in twenty-four hours. This has been observed on the coast of Nova Zembla Proper; but it may be that this is only a meeting of the same tidal waves that flow north and south of Zembla.

7. It is a very remarkable fact that the flood comes at Zembla from the east and north-east. If there are two tidal waves at the Pole, may we not find the solution of the disruption of the ice in midwinter in the combined effect of those tides?

If there are not two tidal waves, then the Spitzbergen waves, making high water at eight and the Nova Zembla at nine o'clock, run to the westward round the Pole, and come back from the east at Zembla.

Or is there any relation between the northerly current in Behring Strait and the easterly current at Nova Zembla?

8. This occasional disruption of the ice, and its movements by gales of wind, makes, I should think, sledge expeditions less practicable and more dangerous, in case there is no land from 82° to the Pole.

9. I cannot believe that there is open water near the Pole in winter, except such as is occasionally caused by disruptions and gales of wind.

The warm under-current brought to the surface at Spitzbergen was frozen in August, when the westerly winds, as often happened, drove the weak ice against the shore.

The party that wintered at Smeerenburg (on the island of Amsterdam, and not on the mainland), cut a hole in the ice, and found that in three or four hours it was frozen again as thick as a hand-breadth.

One year's ice in the ice-bearing current differed in one or another year from 6 to 12 feet in thickness. This ice-bearing current was a continuous current, with more or less open water between the icefields; but I have not found any indication that in the later part of the summer season there was open water, as if the supply of ice was exhausted, as has been found to the north of Zembla, where in 82° there appeared to be a fixed limit to the ice-fields. All the ice that is drawn from the Pole during the summer season must leave an open space behind it, as long as there is no frost to make new ice. And this may have been the open water seen by Morton.

10. Probably the southerly winds in winter at Nova Zembla are the coldest winds, blowing from the large continent; but at Spitzbergen the north and east winds produce the greatest cold, and with a gale of wind they are difficult to stand, even in summer. West and south winds bring snow, and sometimes rain. Therefore, although there is a comparatively mild climate produced by the uprising of the warm under-current at Spitzbergen itself, there is no indication whatever that the climate is more mild towards the Pole.

The influence of the warm current will be felt everywhere, when it is at the surface, and make as great a difference in climate in the same latitude at the Pole as it makes in our latitude, between Liverpool and St. John's, Newfoundland, for instance. The comparison made by the early navigators between the climate of

Spitzbergen and Nova Zembla, not knowing anything about warm currents, gave rise to the belief that the climate at the Pole was exactly like that of Amsterdam in summer.

I hope that an exploring expedition will be sent towards the Pole, east of Greenland; but I think it would be prudent to send steamers every year to Spitzbergen and to Nova Zembla, leaving England in the middle of May, and to be well acquainted with the condition and the movements of the ice before venturing any sledge-expeditions on the Polar pack, north of 82°.

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2. *Account of the Scientific Results of the Arctic Expedition under the Command of Dr. Isaac I. Hayes.* By Dr. I. I. HAYES.

Extracted from the Proceedings of the American Philosophical Society, December, 1861.

THE only published account of Dr. Hayes' important expedition to Smith Sound in 1860-61, in which he attempted to extend the explorations commenced by his predecessor Dr. Kane, appears to be the following report of a paper which he read before the American Philosophical Society on the 6th of December, 1861. The Report being little known or accessible to English geographers, the following reprint of it will doubtless be acceptable. It is necessary to bear in mind that Dr. Hayes had accompanied Dr. Kane as surgeon in the memorable expedition of 1853-5 :—

Upon leaving Boston, July 10th, 1860, my entire party numbered only fifteen persons, and we sailed in a schooner of only one hundred and thirty-three tons burden. My purpose was to follow up the line of research opened by Dr. Kane. I allude, of course, to that of Smith Strait and Kennedy Channel. You will readily understand that I had no such idle purpose as was sometimes popularly attributed to me, viz., that of merely reaching the North Pole of the earth, as a feat of adventurous navigation and sledging. The general object was to procure as much information as the restrictions of our voyage would allow, beyond the termination of Dr. Kane's labours, and in the same direction in which they tended. The space between the point at which his personal observations ended and the North Pole, is about six hundred and fifty miles, an interval sufficiently large to admit of very numerous and important collections. Coinciding with him in the opinion that at some portion of each year there exists a large body of water about or near the Pole, I hope to extend the evidence which he had collected on this subject as well as on many others. It would, of course, have been a source of the highest satisfaction to have succeeded in setting at rest the question of open water, but it was by no means the sole object of the Expedition.

I will not dwell upon the details of our voyage to Greenland, which was unusually boisterous. The schooner was unavoidably so heavily laden that her deck was never more than 18 inches above the water, and was never dry, After touching at Pröven and Upernavik, we reached, on the 21st of August, Tessuissak, the most northern of the Danish stations, in latitude 73° 40′. At all of these places we were kindly received, and the officials furnished me with every facility in their power for procuring the requisite furs and dogs for sledge travelling. Our route lay thence northward through Melville Bay, the general